

that it is a true species, and in no way distorted. The spine is granulated but it does not extend to the last whorl. Mr. Smith states "that the granules are arranged in such a manner as to form oblique series in two directions or in a criss-cross direction; they are excessively minute and crowded upon the topmost whorls, and gradually enlarge and become further apart as the shell grows. In addition to the sculpture already mentioned, there are indications on the body whorl of a few shallow transverse indistinct sulci, with faintly elevated broad ridges between them, especially around the middle. The apex of this species is peculiar; for the nucleus coils in and downwards and is less raised than the second whorl." The granulation around the spine of this species is very much after some of the Australian forms.

THE TIME OF THE GLACIAL PERIOD IN NEW ZEALAND.

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In a recent Paper (1) I described the principal Glaciers of New Zealand of the present time, and I have found occasion several times to refer to the Glacial Period, which has left most striking traces in all parts of that country.

Von Haast (2) has furnished a Map of the Glaciers of the cold period, which shows that several of the ice-streams of that period extended down to the sea.

I had occasion to observe the characteristic scratches on the rocks in the Sounds of the West-coast close to the waters edge, which prove the correctness of Von Haast's views.

The Sounds in the southern part of the West-coast of the Middle Island of New Zealand are a most striking topographical feature. Similar Sounds are found in Norway and Kamtchatka, also there the traces of glaciers are to be seen on their steep sides.

(1) *R. v. Lendenfeld*. Der Tasman Gletscher und seine Umgebung. Petermanns Geografische Mittheilungen. Ergänzungsheft.

(2) *T. v. Haast*. Geology of Canterbury and Westland, Plate II. p. 371

The South-west corner of the Middle Island of New Zealand is a plateau 3000 to 5000 feet in height, which sinks abruptly towards the Western Ocean.

Numerous valleys extend from the open sea towards the interior of the Island which are remarkable for their small width the steepness of their rocky sides and their length. Along a coast line of 150 miles there are fourteen such Sounds which are similar to one another, about a mile broad and from ten to thirty miles long.

The sea stretches nearly to the ends of these valleys filling them up from side to side. The rocks rise steep and abruptly from the sea on all sides. The water in these Sounds is extremely deep averaging 100 fathoms, but what appears particularly remarkable is the fact that the water in many cases is deeper towards the interior than it is at the mouth. Small rivers pour from the sides of these Sounds into the sea, and there is always a larger one at the end. But it does not appear that the débris brought down by these mountains torrents has affected the depth of the water in the Sounds. And scarcely do we find a small delta pent up between the rocks at the mouths of the terminal rivers. This together with the great depth and the fact, that the rivers bring down a great amount of rock and sand, shows that the Sounds cannot have existed long, for otherwise they would necessarily have been filled up more or less by the material which is continually being deposited at the bottom of their still waters.

The character of the sides of the valleys shows, that they were originally produced by flowing water and that they were filled with glacier streams afterwards. As long as they were filled with ice nothing could be deposited in them, and we must assume that the land sank whilst this was the case; because if it had not been so, the originally shallow part would have been filled up by the rivers, partly at least, more rapidly than it could sink as such high mountains stand around it. Finally, when the land had sunk so much, that the bottom of the valley was 100 fathoms below the sea it got warmer and the ice receded up the mountains, and the

sea filled the vacant place ; then the process of filling in commenced, and we can calculate from the quantity of material deposited at the river mouths the time which has elapsed since then.

There is no doubt, that the New Zealand Glaciers were large all over the Island at the same period, and that therefore the Glacial period was simultaneous with the subsidence of land and later than the formation of the Sounds.

The minuteness of the Deltas mentioned above would lead one to suppose that they are of no great age and comparing them to similar alluvial formations which have been produced in the European Alps in historic time, one must come to the conclusion, that the Glacial period in New Zealand has not been more remote than two or three thousand years. This would account also for the extremely fresh appearance of the old moraines and ice scratches.

This part of the West coast, has, as far as it is known, never been inhabited by Maoris and the Middle Island never appears to have been at all thickly populated by them. To judge from their myths, they immigrated from the North, probably after it had begun to get warmer, and with them came animals and plants, the Glacial Fauna and Flora receding with the Glaciers at the margins of which even now the greatest number of plants and even birds are found.